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ABSTRACT

This case study presents information about a graduate-level certificate program in human computer interaction that was added to the Rensselaer Polytechnic Institute (New York) satellite video program in 1996, as a cooperative program between the institution and the IBM Corporation. The program was designed for individuals who work in computer industry occupations where human-computer interfacing efficiency is important. Four courses, featuring a "humanized" distance learning model that incorporates significant interaction during the synchronous broadcast events, were developed. Results of the study indicated that: (1) there was little variation among final grades for students enrolled in the three modes of study (studio site, videoconferencing sites, and videotape sites); (2) students at the videotape and studio sites rated the course slightly higher than those at the videoconferencing sites; (3) remote site students rated the course somewhat below a traditional course; (4) 77 percent of respondents indicated that they would not have been able to take the course if it had not been delivered to their workplace; (5) faculty felt that using technology in these courses improved their teaching overall; (6) tuition revenues more than covered the direct costs of providing the program; and (7) the program

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appears to generate learning outcomes at least equivalent to campus instruction. (MAB)

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The Human Computer Interaction Certificate Program at Rensselaer Polytechnic Institute:

A Case Study in the Benefits and Costs of a joint Industry/University Designed Program Featuring Integrated Delivery Methods

RSVP

Rensselaer Goes The Distance

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A Case Study in the Benefits and Costs of a Joint Industry/University Designed Program Featuring Integrated Delivery Methods

RSVP
Rensselaer Goes The Distance

Summary, Findings, and Conclusions

1. The subject of this case study is a graduate level certificate program in Human Computer Interaction (HCI) that was added to Rensselaer's Satellite Video Program (RSVP) during 1996 as a cooperative effort between RSVP, Rensselaer's Department of Language, Literature, and Communication, and IBM Corporation.

2. The program was designed for individuals who work in computer industry occupations where it is important to be aware of how people can interact effectively with computers. The program consists of four courses developed specifically for this program and represent the most current thinking in the critically important area of how people interact with computers.

3. The program features a "humanized" distance learning model that incorporates significant interaction during the synchronous broadcast events. The instruction is designed so that students regularly participate in class by telephone, videoconferencing, faxed responses, and computer presentations. The courses feature weekly workshops in which students and faculty work informally at problem solving. The coursework also features significant asynchronous components using videotape, course home pages on the World Wide Web, computer conferences, and e-mail.

4. The intent of the Benefits Scorecard, shown below, is to provide a brief summary of the benefits of the particular form of mediated instruction compared to regular on-campus instruction as it relates to this particular case. In particular, the comparison scores can be interpreted as follows:

positive	the mediated instruction used for this case provides more of the benefit than on-campus instruction
neutral	the benefits are equivalent
negative	on-campus instruction provides more of the benefit

Benefits Scorecard: Human Computer Interaction Program Compared to Regular On-Campus Instruction

Benefit	*Score*
Learning Outcomes	
(The comparisons of learning outcomes refer to students at the broadcast studio site and at various receive sites)	
• Course grade comparisons	neutral
• Student survey (spring '97)	
Course overall	positive
Remote site students ("as compared to a regular course")	negative
• Student survey (past students)	positive
Materials valuable to work (70%)	
Would recommend other employees take course (66%)	
Student Access	
Between 200 and 300 new working professionals at receive sites as students at Rensselaer next 3-5 years	positive
Student survey (spring '97) 77% of receive site students would have been unable to take course if it had not been offered at worksite	positive
Institutional Renewal and Growth	
Excellent example of business-university partnership	positive
Creation of four new cutting edge courses developed by corporate professionals and Institute faculty	positive
Faculty indicate benefits to their teaching strategies from working with corporate employees and with the instructional technology	positive
Success with reaching corporate clients has led Rensselaer to rethink the role of RSVP	positive
Social Benefits	
The HCI certificate has potential to improve an individual's ability to work more efficiently with computers and software	positive

Benefit Comparisons

Learning Outcomes

5. (a) For the HCI course evaluated, there was little variation among final grades for students enrolled in the three modes (studio site, videoconferencing sites, and videotape sites).

   (b) Students at the studio and videotape sites rated the course overall between good and excellent. Those at videoconferencing sites rated it between average and good.[1]

   (c) Remote site students rated the course somewhat below a traditional course.

   (d) Seventy percent of the respondents to a survey of employees who had completed courses in this program at remote sites prior to spring 1997 definitely felt the course materials were valuable to their work and worth the investment of their time. Sixty-six percent would recommend that other employees at their company take the course(s).

Student Access

6. (a) Rennselaer expects 200 to 300 more new working professional students at remote sites over the next five years as a result of this program.

   (b) Seventy-seven percent of respondents to the survey mentioned in item 5(d) above indicated they would not have been able to take the course if it had not been delivered to their workplace.

Institutional Renewal and Growth

7. (a) The HCI certificate is an excellent example of a business-university partnership in which Rensselaer drew upon one of its own strengths in teaching technical communication to fulfill a need for advanced training in the business community.

   (b) The campus will add four new cutting edge courses at the graduate professional level. The objective of these courses is to improve the human-computer interface (the efficiency and effectiveness with which people interact with their computers and software).

   (c) Rensselaer faculty teaching in the program indicated that working with business professionals to design the courses and interacting with employee practitioners who were taking the courses enhanced their own understanding of the subject matter.

   (d) These same faculty also indicated that using the technology in teaching the three different student groups provided opportunities and motivation to rethink their own teaching strategies.

   (e) The success of the RSVP program in reaching corporate clients has led Rensselaer to begin a complete rethinking of how such instructional activities can be incorporated into its mission and priorities.

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[1] This finding (5b) and the one immediately below (5c) are qualified by two facts: (1) the satellite transponder used by RSVP failed very early in the course thus requiring that satellite receive sites be converted to either videoconferencing or videotape delivery, and (2) the survey response rate for the videoconferencing sites was only 14 percent, and for the videotape sites it was 44 percent.

Social Benefits

8. The objective of this program, to improve human interaction with computers, has tremendous potential to improve efficiency by improving the quality of software and hardware documentation and instructions thus reducing the time it takes individuals to learn how to operate new software and computers. Because of the nature of the topic, the graduate professional level is the appropriate level to address it. The program could not have incorporated the working professionals, nor would the incentive for corporate involvement have been as strong, without the potential for delivery to several remote sites.

Financial Considerations

9. The RSVP program, of which the HCI certificate is an example, has generated sufficient revenues to pay its operating and capital expenses and to provide additional funds to both the Institute and its academic units.

10. Typical graduate level RSVP courses are more expensive than classroom courses until annual course enrollments (as distinct from section size) are in excess of 65 to 80 students; at larger annual enrollment levels, the RSVP courses are less expensive.

Conclusions

11. The HCI program appears to generate learning outcomes at least equivalent to on-campus instruction. The RSVP program has substantially improved access on the part of corporate customers to Rensselaer's instructional program. This in turn, has improved access for the professional level corporate workforce.

12. Participation in the program has provided important incentives for the Institute and for its faculty to develop new courses and to become better acquainted with the delivery technology.

13. Tuition revenues more than cover the direct costs of providing the program. Net revenues are returned to defray Institute overhead, to participating academic units, and to RSVP's contingency and reinvestment fund.

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Background and Context

Rensselaer Polytechnic Institute

Rensselaer Polytechnic Institute is America's oldest technological college. It is located on a handsome, historic campus overlooking the Hudson River in Troy, New York. Founded in 1824 by Stephen Van Rensselaer "for the purpose of instructing persons...in the application of science to the common purposes of life," Rensselaer has grown into an internationally respected technological university offering graduate and undergraduate degrees in engineering, science, management, architecture, and humanities and social science. Approximately 6,000 students are enrolled in its campus-based programs. Another 900-plus corporate students participate in Rensselaer courses and degree programs via distance learning technology. Stephen Van Rensselaer's vision has remained a significant influence in the history and development of Rensselaer as reflected in its modern mission statement:

> Rensselaer educates the leaders of tomorrow for technologically based careers. We celebrate discovery and the responsible application of technology to create knowledge and global prosperity.

Rensselaer Satellite Video Program (RSVP)

It is not surprising that a university with the technological emphasis of Rensselaer would be one of the relatively early adopters of distance learning approaches. In 1987, with the encouragement of IBM, Rensselaer launched its distance learning initiative—now known as the Rensselaer Satellite Video Program (RSVP). This program had the dual purpose of providing employers with access to cost-effective instruction to maintain the technical currency of their workforce; and enabling Rensselaer to reach many new students who, for reasons of time, space, and mobility, could not come to the campus in Troy. When RSVP began in 1987, it was a satellite-delivered program. Today its delivery technologies include satellite, videoconferencing, videotape, the Internet and the World Wide Web.

RSVP has been a significant success for Rensselaer both educationally and financially. When it began in 1987, RSVP offered one master's degree program to 60 students at five locations of one corporation—IBM. In its tenth anniversary year, RSVP now serves over 900 students at more than 50 sites representing many of this nation's leading corporations, including: Allied Signal, AT&T, DuPont, Ford, General Electric, General Motors, IBM, Lockheed Martin, Lotus Development, Perkin-Elmer, Pitney Bowes, United Technologies, and Xerox. Eight full master's degrees are available to distance learning students who can complete their program of studies without coming to Troy. Additionally, students can choose from a range of technically oriented certificate programs that are typically comprised of four graduate level courses. More than 600 students have now received Rensselaer MS degrees through RSVP. Over the years RSVP's reach has expanded to areas outside the U.S. including Canada, Mexico, Asia, and Europe. Through this program, Rensselaer has been able to add many students to its courses who would definitely not have participated otherwise.

RSVP is operated as an "intrapreneurship" within the university and is financially self-reliant and self-sustaining. The tuition revenues generated from its activities cover all costs including the personnel who staff the program. Funds from the tuition are also returned to participating academic departments, schools and the Institute itself. Annual revenues have grown from $120,000 to over $3,500,000 in the ten years of its existence.

A basic premise of RSVP is to provide employer clients and employee students a single point of contact for all aspects of the program. RSVP initiates and coordinates all aspects of program design and development with the client and the academic departments, handles all of the financial transactions, and, since students must meet Rensselaer's regular graduate admissions requirements, the evaluation of student records prior to admission and the maintenance of student records after admission.

The RSVP model involves interactions with two levels of clients: the employer who decides to make Rensselaer programs and courses available to its employees, and the individual employee at a participating organization who decides to actually enroll. In its current form, RSVP does not market its programs to individuals. Rather, RSVP targets companies and organizations who may benefit from the partnership and enters into agreements with them to bring Rensselaer programs on site using distance learning technology.

There is a straightforward economic rationale that underlies distance education efforts of this type. When an employer decides to undertake an educational/training program for employees, a comprehensive set of cost factors comes into play. Since employees are involved, the employer's costs may include wages paid to employees while they are taking classes (thus internalizing the cost of the foregone earnings that regular university students experience when they attend courses instead of having a full-time job), the costs of subsistence and transportation for the students to the instructional site (again, a cost that regular students ordinarily bear), as well as the fees and tuition that students ordinarily pay. If the tuition is paid to a private educational institution and covers the total costs of the instructional program, the employer has, in effect, internalized all the costs of the program, the costs of the instruction, the costs of student living expenses and travel, and the cost of foregone wages (which in this case may actually be paid).

One would expect employers to adopt training strategies that minimize their total costs for any given level of program quality and number of students instructed. If all of the costs of the program are borne by the employer, then any of the various costs may be traded off for others in terms of reducing the total.

It is crucial to understand that the electronic and digital technology substantially increases the range over which these trade-offs can be made. Given a cost-minimizing perspective, it is not surprising to observe a preference to have the course come to the employees at a worksite rather than pay to have several employees travel to a campus (thus reducing the costs associated with travel and subsistence, as well as reducing paid travel time while not working). Bringing a live instructor to a worksite, while it may be less expensive than sending employees to a campus, also has limitations especially if the employer has several sites with just a few potential students at each location.

The various modes of instructional television and other forms of distributed learning are well suited to providing the course at a worksite thus minimizing travel, subsistence, and wage costs associated with obtaining the instruction for the employees. Additionally, electronic delivery expands the potential student audience over what would be possible by bringing a live instructor to a single worksite. The distance learning technologies are capable of providing education and training at many worksites simultaneously, further reducing the total costs associated with providing instruction to employees.

The Certificate in Human Computer Interaction

The subject of this case study is a graduate level certificate program in Human Computer Interaction (HCI) that was added to RSVP's offerings during summer session 1996.

The HCI certificate is a cooperative effort between RSVP, Rensselaer's Department of Language, Literature, and Communication, and IBM Corporation. The program was designed for individuals who work in or plan to work in the computer industry in occupations such as software developers, program developers, hardware and software engineers, human factors professionals and others with a professional interest in how people can interact effectively with computers. The program consists of four courses,[2] each offered for four units of graduate credit. The courses have all been developed, or are under development, specifically for this program and represent the most current thinking in the critically important area of how people interact with computers. IBM has supported this new program by devoting human and financial resources to the development effort and by guaranteeing a minimum number of students enrolled in the courses.

By fall 1997, RSVP plans to offer two HCI courses per term each with enrollments similar to the spring term course. IBM expects to educate between 200 and 300 employees through this program over the next five years. RSVP also makes these courses available to other companies through its network.

The program features a "humanized" distance learning model that incorporates significant interaction during the synchronous broadcast events. The instruction is designed so that students regularly participate in class by telephone, videoconferencing, faxed responses, and computer presentations. The courses feature weekly workshops in which students and faculty work informally at problem solving. The coursework also features significant asynchronous components using videotape, course home pages on the World Wide Web (for delivery of course information and handouts,) computer conferences (for off-line discussions amongst all individuals involved with the course) and e-mail (for private communication between instructors, graduate assistants, and students).

The courses originate on the Rensselaer campus from one of the RSVP distance learning classrooms. The instructor is in the room with 12 to 25 on-campus students, typically MS or Ph.D. students in the Technical Communication programs. The class is "produced" by a technical team in an adjoining control facility, so the instructor has access to a range of media capabilities but need not do any production work. RSVP is one of a few programs around the country that has integrated satellite and videoconferencing capability in its production studio. Participating sites can receive the signal by satellite or by videoconferencing. If students speak at one of the videoconferencing sites, their image is fed into production and becomes the image all groups see and hear, including the satellite audience. If someone from the satellite audience calls in, their question is heard throughout the network. Because all images are mixed in the production environment, techniques that are not generally available in today's videoconferencing environment can be incorporated (split screens, picture-in-picture, mixing of video and computer images, etc.).

Because the courses are all new and designed for delivery in a distributed learning environment, there are no pre-existing courses with which they can be compared directly for the purpose of this case study. The planned approach to learning outcomes was to compare performance of the students in one of the courses offered in spring 1997 in different locations—in the studio, at videoconferencing sites, and at satellite receive sites. Unfortunately, a rare event disrupted

[2] The courses are: Introduction to Human Computer Interaction, Electronic Coaching Systems, Communication Design for the World Wide Web, and Capstone Design in Human Computer Interaction. Each course meets four hours per week including a weekly workshop session. Students are expected to spend an additional 6-8 hours per week studying and working on assignments. In addition to the certificate, the courses may also be used for credit toward the MS degree in Technical Communication at Rensselaer.

the satellite aspect of this particular course for this particular semester. AT&T's TeleStar 401 satellite, from which RSVP was broadcasting, was destroyed by a major solar flare early in the term. Satellite time rapidly became scarce and more expensive and, as a result, RSVP substituted videotapes or videoconferencing classes at the former satellite receive sites. (Satellite broadcasting was resumed in the summer.)

For purposes of this case, comparisons were made of the performance of the on-campus studio students, the videoconferencing groups, and videotape groups. All of these groups made similar use of the various asynchronous technologies associated with the course as described above. From a cost standpoint, the estimated costs to deliver the HCI course will be compared with revenues from tuition. The costs have been analyzed from the university perspective. No attempt has been made to quantify the costs from the employer perspective, but this program provides an example that is consistent with the cost minimization strategy as discussed above.

Benefits of the Human Computer Interaction Program

Assessment of the benefits of the HCI course is based upon the following considerations:

- Student grades for the HCI course offered in spring 1997 were summarized and reviewed to determine if there was any difference between on-campus students and distance learners, and if the primary delivery mechanism for distance learners (videoconferencing and videotape) had any significant effect upon performance.
- A questionnaire was developed and administered to students at all locations—campus and distance learning sites—in the same HCI course. The questionnaire was designed to elicit feedback regarding academic experience, the relevance of the course's subject matter to the students' objectives, and reaction to the technologies used. The questionnaire also asked for optional identification information by gender, age, and ethnicity.
- A questionnaire was developed and mailed to the homes of all distance learning students who had previously completed one or two courses in the program to determine their assessment of the value and applicability of these courses to their work. This questionnaire also solicited optional identification information by gender, age, and ethnicity.
- A questionnaire was developed and administered by interview to the two faculty members who have taught the two courses that have been offered to date in this certificate program to determine their views of the effectiveness of the program, the technologies employed, and its impact on a variety of factors from the faculty perspective.
- A questionnaire was developed and administered by interview to the department chair of Language, Literature, and Communication at Rensselaer to determine her views on similar matters and the impact of this program on the academic department.
- A questionnaire was developed and administered to the corporate advocate of this program at IBM Corporation to assess his view of the success and viability of this program to date from the corporate perspective.
- Written input was provided by the individual who was director of the Rensselaer Satellite Video Program at the time the program was developed and who prepared the Letter of Agreement between Rensselaer and IBM, to provide insight into the benefits of this program from the university administration point of view.

Learning Outcomes

The students in one of the HCI courses offered spring term 1997 were distributed among the campus classroom (20 students) and 15 corporate sites (80 students). The number of students at a corporate site ranged from 1 to 16. The sites, the corporations, and the enrollments are shown in Table 1. Sites can typically select their primary viewing mode from satellite or videoconferencing delivery. In this particular semester, however, the failure of AT&T's satellite, TelStar 401, required that the satellite sites temporarily switch to videoconferencing mode or mailed videotape mode. Ten sites viewed by videoconferencing and five by mailed videotape.

Student performance in the course as measured by final grades

The HCI course did not have a final exam or a final project. Evaluation consisted of review of 5 mini-projects that were completed by students during the semester. Of the 100 students in the course, 70 received grades of "A," 2 received grades of "B," 27 received grades of "I" (Incomplete), and 1 received a grade of "F." The "I" grades were not factored in the GPA calculation below, as they will convert to actual course grades when the students complete the "I" contract which was arranged with the instructor. Since the one grade of "F" is clearly aberrant for this class, it was also excluded for comparison purposes as it would have skewed the campus grade average. Enrollments at the various sites by mode of instruction and GPAs are shown in Table 1.

It is difficult to draw conclusions from these data because, as is typical of many graduate courses, there is a very limited grade distribution. However, based on the information available, no significant performance difference is noted between those who took the course on campus or at a distance, and for the distance learners, course delivery mode did not make a difference. This result is consistent with experiences in other RSVP courses in the past.

Student attitude as measured by questionnaire to HCI students

A questionnaire was distributed to students in the final class meeting of the spring 1997 semester. The on-campus students completed the survey during class and 18 were returned. Unfortunately, the response rate from the off-campus students was fairly low. This is typical of corporate receive site students, and despite special efforts to secure a high rate of return, surveys were only obtained from 16 of these students. The response rates and characteristics of the respondents are shown in Table 2; the content of the responses is shown in Table 3.

Table 1—Final Grades for HCI Course, Spring 1997, by Site and Delivery Mode

Site/Mode	Grade A	Grade B	Grade I	Grade F	GPA
Videotape					
Delaware Tech	2				4.00
IBM Poughkeepsie	8		2		4.00
General Dynamics	2				4.00
Perkin-Elmer			1		
Xerox	1				4.00
Subtotal	13		3		4.00
Videoconference					
IBM Austin	4		1		4.00
IBM Boulder	9				4.00
IBM San Jose	3				4.00
IBM Rochester, MN	13		3		4.00
IBM RTP, NC	4	1			3.80
IBM Santa Teresa			5		
IBM Toronto			6		
IBM Tucson	7		6		4.00
Lotus Development	1				4.00
Pitney Bowes	1				4.00
Subtotal	42	1	21		3.98
On-Campus	15	1	3	1*	3.94
Grand Total	70	2	27	1	3.97

** The F grade in the on-campus class was excluded from the average GPA calculation as an aberrant grade which would unduly skew the results.*

On a scale of 1-5, with 5 being the highest rating, all students combined gave this course an overall rating of 4.35—between "good" and "excellent." As a whole, campus students responded somewhat more favorably giving the course a 4.55 compared to distance learning respondents who rated it at 4.12. Looking more closely at the distance leaning students, it was surprising to note that those who watched by videotape rated the course considerably higher (4.57) than those who participated live and interactively by videoconference (3.77). Given the highly interactive nature of these courses, one would have expected frustration on the part of those who participated more passively by watching videotapes, but that wasn't the case. All students used several asynchronous technologies as part of taking the course including the Web, listservs, and e-mail.

These technologies apparently provided sufficient alternate means of interaction. It is also likely that the flexibility afforded by the videotapes may have positively influenced student reactions.

Table 2—Survey Response Rate and Characteristics of Respondents in HCI Course, Spring 1997

All Students		Respondents	
On-Campus	20	On-Campus	18
Receive Sites		Receive Sites	
Videoconference Site	64	Videoconference Site	9
Videotape	16	Videotape	7
Total	100	Total	34

Characteristics of Respondents	On-Campus	Receive Sites
Gender		
Male	33%	67%
Female	67%	33%
Ethnicity		
White	72%	92%
All Other	28%	8%
Age Range	21-30	31-50

Table 3 also provides comparisons of student reactions to other key questions. To a question asking if the technologies used enhanced the course, the most positive response came from the on-campus students (4.38), the most negative from those using videoconferencing (2.77). A similar pattern of responses is seen for the related question of whether the technologies enhanced communication, except that all responses were somewhat higher (suggesting, indirectly at least, that a somewhat higher value was placed upon the use of the Web, e-mail, etc., than videoconferencing).

To the statement "The technologies used made me uncomfortable," the group that disagreed the most (indicating the highest comfort level) were those using videotape, followed closely by the campus group. The videoconference group showed the lowest comfort level with the particular technology. When asked, essentially, if the overall quality of this course was better than traditional courses, the videotape group was close to being neutral, the videoconferencing group disagreed, and the on-campus group was slightly favorable.

Table 3—Student Responses to Attitude Survey, Spring 1997

	On-Campus	Videoconf.	Videotape	Total Remote Sites	Total All Respondents
1. Overall course rating*	4.55	3.77	4.57	4.12	4.35
2. The technologies used enhanced this course.**	4.38	2.77	3.71	3.18	3.82
3. The technologies used facilitated communication.	4.44	3.11	3.85	3.43	3.97
4. The technologies used made me uncomfortable.	2.00	3.33	1.57	2.50	2.26
5. Overall this course was better than a traditional course.	3.52	2.17	2.83	2.40	3.00
6. Being in class with corporate students added to the learning experience.***	4.44	-	-	-	-
7. Without the availability of distance learning, I would not have been able to take a course like this.****	-	4.77	4.50	4.66	-

** The responses to item #1 are: 1=very poor, 2=poor, 3=average, 4=good, and 5=excellent.*
***The responses for items #2-#7 are: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.*
****Item 6 was asked of on-campus students only.*
*****Item 7 was asked of distance learning students only.*

On-campus students provided a strong indication that the presence of corporate students in their classes enhanced their learning (4.44). As hoped, they perceived their educational experience as enhanced by being members of a "community of learners" that included sophisticated practitioners using and developing leading edge technologies. Likewise, the distance learning students indicated that they would not be able to take a course like this without distance learning technologies (4.66) supporting IBM's initiative to establish on-site programs.

Respondents generally were quite favorable to this course, rating it between good and excellent. One might have expected campus students, who are not normally exposed to the extensive use of technologies in their courses, to be somewhat negative, but that was not the case. Substantial emphasis is placed on the value of the interactive nature of videoconferencing and it was surprising that the least satisfied respondents were in this category. One possible explanation of the consistently lower ratings that videoconferencing received is that it was less convenient, still requiring attendance at a specific time and place.

Survey of students who had completed a course in the HCI certificate program prior to spring 1997

A mailing to the homes of 65 students who had completed one or two courses in the HCI program prior to spring 1997 also yielded a 20 percent response rate with 13 responses returned. The primary objective of this survey was to determine if students were using the materials gained from the courses in their work, and if they felt the investment of time was worthwhile.

A total of 70 percent agreed or strongly agreed that the material gained from the courses was "very valuable" to them in their work, and 30 percent were neutral to the statement. Likewise, 70 percent felt that what they gained was worth the personal investment of time, 15 percent were neutral to this statement and 15 percent disagreed. Seventy-seven percent indicated that they would not have been able to take a similar course without distance learning delivery to their worksite. While 61 percent would recommend that other employees in their company take these courses, 39 percent were neutral to this statement—a matter for further exploration by the project partners.

Table 4—Survey Responses of Students Who Completed One or Two Courses Prior to Spring 1997

- **Questionnaires mailed** — **65**
- **Questionnaires returned** — **13 (20%)**
- **Age range of respondents** — **31-40**
- **Gender of respondents**
  - **female** — **64%**
  - **male** — **36%**

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
• The course material has been very valuable in my work.	8%	62%	30%	NR*	NR
• The value I gained from these courses was worth the investment of my time.	15%	55%	15%	15%	NR
• I would not have been able to take this or a similar course had it not been delivered to my workplace.	31%	46%	23%	NR	NR
• I would recommend that other employees of my company take this course.	15%	46%	39%	NR	NR

* *NR = No responses in this category.*

In some of the narrative remarks respondents indicated that they found the courses quite valuable but were not yet in the particular job that required application of the knowledge. Others indicated that they were applying the information directly, and a minority felt the courses were too general or too theoretical to be useful in a practical sense. The narrative responses indicated some very positive learning outcomes from the coursework. Several students mentioned that the opportunity to take the courses created the environment for reflection and innovation that is often lost in the rush of everyday work. Others commented how this course had made them aware of the theoretical underpinnings for work that they were doing more on instinct, and forced intellectual engagement in a new way. Another repeated comment was that the courses provided a new set of tools for evaluating interfaces. One interesting comment was that the course created a network of people across sites and companies that didn't exist before, providing access to colleagues engaged in similar challenges. Negative comments focused largely on workload issues—not enough time for the demands of the course while meeting the demands of the company. At least one person suggested that this content could be purchased less expensively from other schools and were concerned about that aspect of IBM's investment.

Form as content

Students participating in these courses are using technology interfaces to complete the course, and effective computer communication is the subject matter; so there is an interesting complement of delivery and content that enhances the learning experience of students.

Access Issues

Educational access is one of the key objectives of this program. Access can be viewed from both the university and corporate perspectives.

The Institute is reaching new audiences, not otherwise accessible. Between 200 and 300 IBM employees, paying full tuition, will be educated through this program over the next several years. These are students that otherwise would not have taken courses from Rensselaer. The potential to reach significant other audiences beyond IBM in the future is great. This program also provides visibility for RSVP at new corporate locations and may lead to additional enrollments in its other degree programs as well.

From the corporate perspective, these courses provide 200 to 300 IBM employees access to courses and information that otherwise would not be available to them, improving their own competitive advantage and that of their company. The vast majority of students indicated that they would not be able to take such courses without distance learning technologies. IBM's corporate advocate cited the advantage of having large groups of employee-students exposed to similar concepts, making for a more integrated/unified educational program than if many individuals went off and sought out singular, isolated learning experiences.

Although IBM students are currently given priority, students from other corporations can participate in the program as space allows. This enables students from other companies to receive the benefit of IBM's investment and cutting edge knowledge in computer interfaces. IBM has encouraged Rensselaer to expand the program to include many other companies because computer interface design is an industry-wide issue and they believe their employees (and the company) can benefit from the perspectives of other employees and companies as well.

Institutional Renewal

Faculty Development

An important outcome of this program is a form of faculty education or development. IBM Corporation and the faculty program developers formed a reference group which meets periodically to discuss the development and continuous improvement of these courses. This approach, providing the practitioners with theoretical approaches to their problems and providing the theoreticians with issues as they are being addressed in the real world, is an invaluable forum for exchange of ideas between Rensselaer faculty and IBM user-interface professionals.

One of the faculty members interviewed felt that learning to use the technologies interactively made him more aware of positive teaching approaches that carry over into all his teaching. Another faculty member said that this program is making him and his colleagues more "healthy and in-touch."

Institutional Growth and Development

Another significant aspect of this program is the variety of advantages that have accrued to the institution:

- This program is bringing four new leading edge courses into existence that wouldn't have existed otherwise. IBM not only invested money in course development, it also contributed expertise in developing the cutting edge content. The resulting courses are available to both distance learning and campus audiences.
- These courses resulted in new use of existing distance learning broadcast infrastructure, and the expanded use of supportive technologies such as the World Wide Web, listservs, and the Internet. The leadership influence of this program is now impacting other courses and programs offered by RSVP and setting new standards for interactive distance learning. The courses provide for both synchronous and asynchronous learning experiences, thereby allowing the learner to have more control over time and place of learning, and faculty to gain experience with new instructional formats.
- These, and other distance learning courses, have become the basis for models of revenue sharing with faculty, departments, and schools that provide new incentives for entrepreneurial activity and innovation. The department chair indicated that funds generated by this program are being used to create the "Collaborative Design Classroom," a new facility that will benefit faculty, campus students, and distance learners.
- This program has provided Rensselaer an entry to major corporate locations across the nation, expanding both its visibility and reputation.
- This program capitalizes on existing technical infrastructure and satellite time. It resulted in added income without significant new expenditures.
- The program has diversified Rensselaer's student population. Rensselaer does not have a significant continuing education population involved with on-campus programs. This program through its outreach activities brings in the working professionals with their different perspectives on the course materials. It is interesting to note that the on-campus class had no students over 30 and the off-campus group had none under 30.

Social Benefits

- Now that computer use has extended to all walks of life, there is a need to design new computer interfaces that allow users to complete useful tasks with minimal learning. Effective computer interfaces could result in staggering savings of time and effort across every imaginable field. It is hard to imagine a subject matter that could have more direct impact on productivity and competitiveness.
- Rensselaer is capitalizing on its early success in distance learning and applying that to new models and technologies. This can serve as a model to other universities for establishing effective corporate-university partnerships.
- American industry spent $53 billion on education and training last year. Much of that is duplicative across industries. Not all of it is spent effectively. This program can demonstrate how universities can work with American corporations to establish effective programs to maintain national competitiveness.

Challenges

In spite of its significant successes, there remain some challenges with the HCI program that remain to be worked out.

The department chair and faculty all cite the tremendous workload of developing and maintaining courses that serve so many students and that remain at the cutting edge of the discipline. The workload can negatively impact the ability of faculty to do research, and care must be taken that participation in this program does not mean falling behind in research matters. Some of the new revenues generated can help, by allowing for the hiring of new personnel. However, there is always a lag between the initial efforts and the catch-up of resources to help with increased load. The department is now in the throes of this dilemma as it debates stabilizing at current levels or moving to expand the program.

A number of students cite the workload problem as well. They are finding it difficult to devote the time needed to study given the demands of their workplace. This is a challenge for IBM and other participating companies to ensure that leadership is providing encouragement and support enabling students to take advantage of the corporate investment. It is also a challenge for Rensselaer to develop formats that are as flexible as possible given the multiple demands on these learners.

The department chair and faculty members feel that the current model is transitional between the traditional classroom model and the teaching/learning model of the future that will be more flexible, more collaborative, and will have more asynchronous elements. RSVP itself must overcome some of its more "traditional" distance learning approaches to help in this process.

As mentioned above, IBM would like to see the program expand more rapidly to include other industry partners and that must be traded off against the workload factors mentioned above. Despite these challenges, this program, like RSVP itself, represents a great success for Rensselaer—educationally, financially, and in terms of its mission to "educate the leaders of tomorrow." It also demonstrates IBM's leadership, once again, in forging and supporting educational partnerships.

Estimated Costs for the HCI Courses

The basic approach to the cost estimates is to include all direct costs of the courses whether they are operating, e.g., faculty and staff, or capital, e.g., equipment and facilities (in which case the annual amounts that can be attributed to a course must be imputed as discussed below). The costs of the courses are accounted for in accordance with the Case Study Manual developed for this project[3] with certain modifications to accommodate unique aspects of the RSVP program, especially the revenue aspect.

Specific costs associated with the HCI courses are as follows:

1. Faculty Staffing Costs—Because faculty who participate in the RSVP courses teach in a live studio to live students in a class similar in size to a regular Rensselaer graduate level course, the cost of putting the instructor in the classroom is excluded from the estimate as is the tuition revenue from the classroom students. The faculty cost that is included consists of three components: a one-time payment of $1,500 for the first time a faculty member participates in an ITV course (to prepare the course materials for the course), an overload payment of $3,000 or 5 percent of annual salary, whichever is greater, each time the course is taught, and a payment of $50 per RSVP student enrollment over 40.

2. Graduate Assistants—In addition to direct compensation to faculty for working with the additional remote students, RSVP also allocates graduate assistant funds in the ratio of 10 hours per week for every 20 remote students enrolled. The graduate assistants work with the faculty on course assignments, answer student questions, prepare handouts and materials for delivery via the WWW, and assist with other logistics of course presentations. Including stipend and tuition, this amounts to approximately $4,800 per term for every 20 students or a per student cost of $240.

3. Studio Operations—Rensselaer provided operating cost estimates for the studio staff and operating expenses, including costs of the satellite network, for an annual total of $812,000. Studio use amounts to approximately 1,840 hours per year (52 hours per week for two 15-week semesters and 40 hours per week during a 7-week summer term). One 4-unit HCI course generates 60 hours of studio use or about 3.261 percent of the entire studio time. Since the 1,840 hours represents a realistic level of utilization for the facility, the percentage is used to allocate a share of the studio costs to a single course, i.e., $26,470.

4. Imputed Capital Costs—Rensselaer provided an inventory of capital equipment costs and estimated useful lives. Dividing the equipment costs by estimated useful lives and summing provides an estimate of the annual imputed equipment cost of $44,450.[4]

   Finally, an annual space cost of $17,000 was imputed based upon an estimate of 850 square feet directly involved with the studio operation and a lease rate of $20 per square foot per year.[5]

   The estimated annual direct costs for both equipment and space were allocated to the course using the same proportion (3.261 percent) as was used in item 3 above, the total imputed capital cost was $2,006 ($1,450 plus 556).

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[3] F. Jewett, *Case Study Manual: Evaluating the Benefits and Costs of Mediated Instruction and Distributed Learning*, CSU Chancellor's Office, Los Alamitos, November 1996, pp. 14-25.

[4] These imputed annual costs are not out-of-pocket expenditures. They represent an estimate of the annual value contributed to the operation by capital assets purchased at some time in the past. Alternatively, they may be thought of as estimates of the lease costs of the equipment.

[5] Triple net lease, class B property in moderate location, older, low-rise building, finished interiors.

Chart 1 below shows a graph of the combined direct cost estimates (items 1-4 above) for the HCI course for enrollments up to 85 receive site students. The chart also shows tuition revenues associated with the enrollments. Estimated net revenues for the course (the difference between revenues and direct costs) are distributed to defray Institute overhead, to the participating academic departments, and to RSVP's contingency fund and reinvestment account.

The estimated direct costs of the course include a fixed cost component (independent of course enrollment levels) of faculty start-up and overload payments, an allocated share of studio operation costs, and an imputed share of RSVP's capital costs. Direct costs increase with enrollment in accordance with the funding for faculty at the rate of $50 per student for receive site enrollments over 40 and as additional graduate assistants are funded per block of 20 receive site students. The revenue schedule is calculated at Rensselaer's regular tuition rate of $570 per unit (reduced by approximately $270 per student to adjust for the costs of RSVP's program and student support activities).

The course has a break-even enrollment of about 15 receive site students. For enrollments above that level, the course is a net revenue generator.

Chart 1—Revenue and Direct Cost Estimates, HCI Course